MODULE 5 REFERENCES

ITS/CVO Program Areas: Electronic Screening

US Dept of Transportation

Weigh in Motion (WIM)

- Weigh vehicles while moving
  - From slow to highway speed
- Estimates axle weights and gross vehicle weight
  - Not as accurate as static scale
- WIM not required for Electronic Screening
  - Weight enforcement can be accomplished without WIM

Weigh in Motion (WIM)

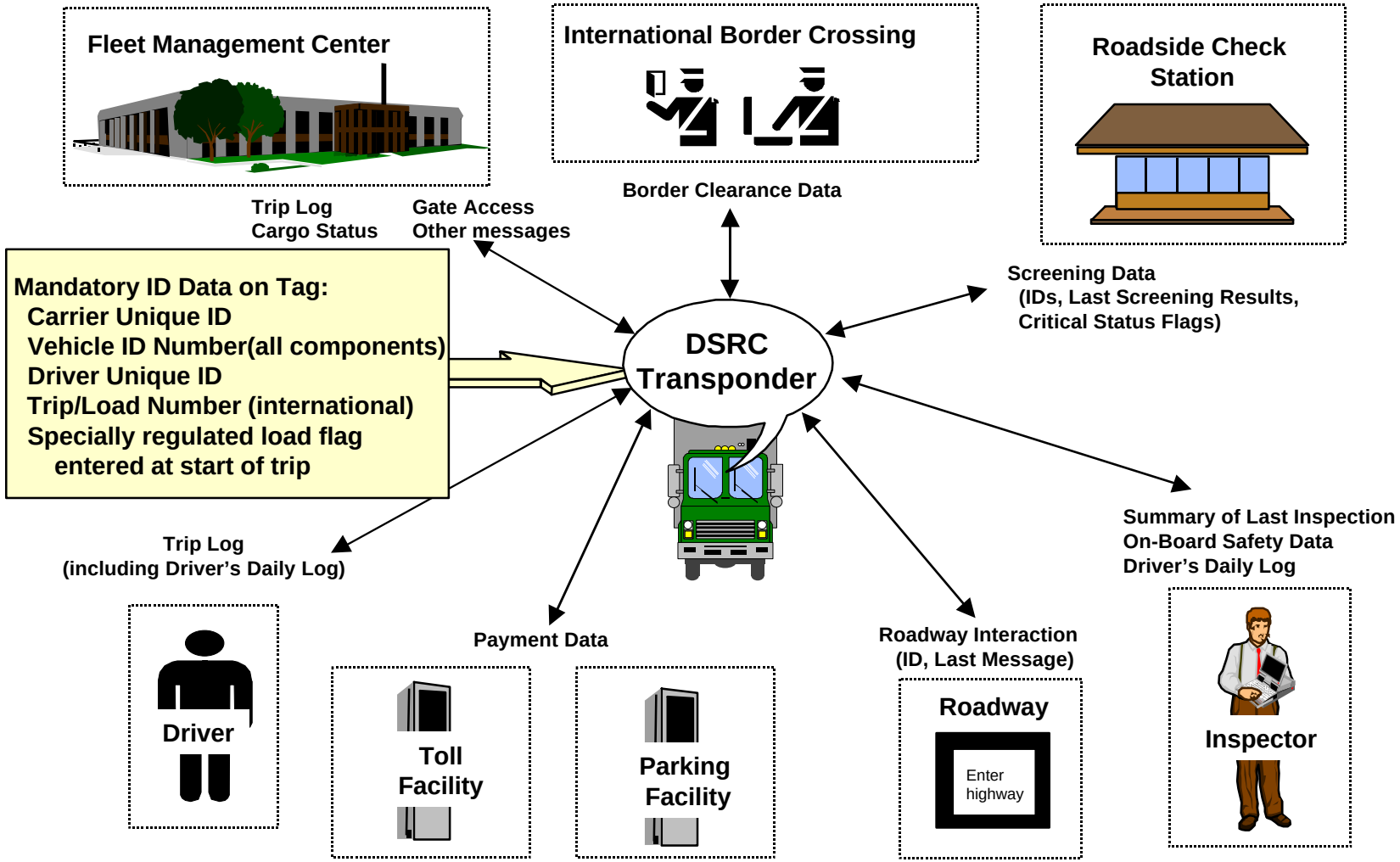
Weigh In Motion (WIM): Weigh In Motion is used to measure approximate axle weights as a vehicle moves across the sensors, and to determine the overall vehicle weight and classification based on the axle weights and spacings. Although not as accurate as a static scale, WIM allows the weight of a vehicle to be estimated for screening purposes, while maintaining traffic flow

Various speeds have different purposes:

- Mainline: rough estimate of weight; determine if vehicle is significantly below limits
- Ramp-sort: Better measure; determine whether to send to static scale or bypass lane
- Slow rollover: Good measure but quicker than static scale

DSRC - Definition

DSRC standards are used in CVO to read information from a vehicle-mounted transponder while the vehicle is in motion.



DSRC in Electronic Screening

DSRC is used to provide data communications between a moving vehicle and the roadside equipment to support the screening process. This is accomplished by means of a transponder mounted in the cab of the vehicle, and a reader and antenna mounted at the roadside. The tag contains identifiers specific to the vehicle (carrier and vehicle IDs at a minimum), plus optional past screening information. The screening computer uses the tag information as part of the overall screening algorithm, and then uses audio and visual indicators on the tag to communicate the screening decision back to the driver. Current screening information may also be communicated back to the tag for future use.

- Identification data input via port on tag
  - Carrier ID: US DOT number and FEIN (tax ID)
  - Vehicle ID: VIN (Vehicle Identification Number)
  - Driver ID: Commercial Driver's License #
- Previous Event - Data from earlier weigh station
  - Station location
  - Date/Time
  - Weight and axle data
- Signal on tag
  - red, yellow or green light
  - audible tone

Electronic Screening Site Layouts

For electronic screening, the major design elements include vehicles, manned fixed or mobile roadside check stations, the state commercial vehicle information exchange system window (CVIEW), the state CV safety administration, and various multi-state information systems.

Vehicles **are equipped with electronic tags (transponders) that support dedicated short range communications (DSRC) and are integrated with an in-cab display (visual and audio) used for driver notification. Various techniques may be used to store driver and load information on the tag. Vehicles typically interface with screening equipment at mainline speed and drivers are notified of bypass status via the in-cab device.**

Fixed commercial vehicle roadside check stations **are manned locations with a permanent structure that can house elements of the information system (e.g., computers and communication systems). The stations are equipped with dedicated short range communications (DSRC) systems for interfacing with tagged vehicles. License plate readers may be used to identify untagged vehicles. Fixed sites are usually equipped with some weighing device (weigh-in-motion (WIM) device or a static scale). A more sophisticated configuration includes a screening WIM device integrated with an automated vehicle classification system to perform weight, size, and length checks, and a static scale to measure weight more precisely when the vehicle is stopped. If the WIM and automatic vehicle classification (AVC) system are located in the roadway on the mainline, then "screening" (making pass/pull-in decisions) can be performed at mainline speed. Manned fixed sites are likely to be co-located with a safety inspection facility.**

Mobile enforcement units **can be equipped with various combinations of DSRC, automatic vehicle identification (AVI), AVC, and WIM systems. They are typically positioned in areas where violations are known or suspected to occur. These units are equipped with tag readers that allow them to interface with vehicle transponders and mobile computers that look up credential and safety records either locally or stored in the infrastructure.**

State administration **systems support electronic screening operations in that they provide CVO data required for electronic clearance. The results of roadside activities (vehicles that were seen and cleared, seen and stopped, inspected, citations issued, number of vehicles that passed the station, etc.) are provided to the state CV safety administration.**

Core infrastructure systems **such as CDLIS may be queried either directly or indirectly to gather safety, license, and enforcement information about the carrier, vehicle, and driver.**

Video Advantage CVO

What is Advantage I-75? Advantage I-75 is a public/private partnership along the Interstate-75/Highway 401 corridor. The goal of the partnership it to improve travel on the corridor (i.e., make it safer, faster, and less congested) through the use of advanced technologies.

What is MACS? The current effort being conducted by the partnership is an operational test of the Mainline Automated Clearance System, or MACS. The objective of MACS is to allow transponder-equipped and properly documented trucks to travel any segment along the entire length of the corridor at mainline speeds with minimal stopping at enforcement stations. With MACS, participating trucks can be processed electronically on the mainline as they approach weigh stations. If the system determines that the truck's weight and credentials are legal, the truck is allowed to bypass the station.

How does MACS Work? Each truck enrolled to participate in the MACS Operational Test will be equipped with a transponder, a two-way communication device that mounts on the windshield in the truck's cab. The transponder communicates with roadside readers to allow the system to identify the truck and check the truck's credentials. Weight data can be stored in the truck's transponder from an earlier weighing (on the same trip), or it can be obtained from weigh-in-motion equipment. If the system determines that the truck's weight and credentials are valid, it sends a preclearance signal to the transponder. The driver then sees a green light and hears a distinctive audible signal, telling him or her that it is OK to bypass the station.

Video Advantage CVO

What is the Scope of MACS? MACS is being installed at thirty weigh stations on Interstate-75 and Highway 401. Twenty-two of these sites are in the United States, from southern Florida to Detroit, and eight sites are in Ontario. Approximately 4,500 trucks are being enrolled and equipped with transponders for participation in the Operational Test.

Who are the Project Partners? Partners in Advantage I-75 include enforcement and regulatory agencies in Florida, Georgia, Tennessee, Kentucky, Ohio, Michigan, and Ontario; the Federal Highway Administration; motor carrier groups; individual trucking companies; the University of Kentucky's Transportation Center; Iowa State University's Transportation Center; Science Applications International Corporation (SAIC); Hughes Transportation Management Systems (HTMS); and Delco Electronics. The Kentucky Transportation Cabinet is the lead agency for the project, and the Operations Center is located at the University of Kentucky.

How can I Learn More about Advantage I-75 and MACS? Send electronic mail to the Advantage I-75 Operations Center at the University Kentucky. The toll-free number is (800) 472-MACS.

Video HELP PrePass

PREPASS: PrePass is a sophisticated intelligent transportation system (ITS) that electronically identifies subscribing commercial vehicles, verifies state-required operating credentials and checks both axle and gross weight as trucks bypass designated weigh stations and port-of-entry facilities at highway speed -- eliminating the need to stop.

ADVANTAGES: PrePass allows freight companies, shippers, independent operators and drivers -- virtually anyone in the trucking industry -- the ability to save valuable time, reduce operating costs and improve safety and efficiency. Participation is voluntary.

VEHICLE EQUIPMENT: PrePass subscribers are issued an easily installed in-cab transponder kit for each vehicle enrolled. The kit consists of an in-cab transponder, easy-to-read installation instructions and FHWA waiver. The transponder communicates with PrePass weigh stations via radio frequencies and can be installed on any vehicle in less than 30 minutes. The in-cab transponder measures 4½ inches wide by 3¼ inches high and 1½ inches thick, and installs inside the cab approximately two inches to the right from the center of the windshield and three inches from the top. This device communicates bypass status to the driver via a green or red light and distinct audio signals. A new, easy-to-install battery operated transponder is also available. PrePass is dedicated to improving the system through vendor participation and carrier comments.

Video HELP PrePass (cont.)

TECHNOLOGY: PrePass weigh stations and ports-of-entry utilize an automatic vehicle classification (AVC) system, employing weigh-in-motion (WIM) sensors and automatic vehicle identification (AVI) antennas to electronically weigh and verify the identity of trucks as they approach the weigh stations. As a truck passes over the WIM, the distance between axles is measured and the weight of each axle or combination of axles is recorded and used to calculate the truck's total gross weight. The in-cab transponder identifies the truck to the weigh station computer, which verifies state-required credentials and safety history. After the truck is weighed and credentials verified, a vehicle-to-road communications (VRC) antenna at the site communicates bypass status to the driver via the in-cab transponder. A green light and audible signal advises the driver to bypass the weigh station if weight and credentials are satisfactory. If weight or credentials cannot be verified, a red light and audible signal advises the driver to pull into the weigh station for inspection.

CAPABILITY: There are currently 11 operational PrePass sites in California. On Interstate 5: Dunsmuir Grade Inspection Facility at Mount Shasta; Santa Nella (northbound and southbound) platform scales near Los Banos; Grapevine (southbound) Inspection Facility near Wheeler Ridge; Castaic (northbound) Inspection Facility in Santa Clarita County; Cottonwood (northbound) platform scale near Redding; San Onofre (southbound) Inspection Facility near the San Diego County line. Additionally, Desert Hills (eastbound and westbound) Inspection Facility on I-10 near Banning, and Livermore (eastbound and westbound) on Interstate 580 are equipped.

Video HELP PrePass (cont.)

Currently, there are four operational PrePass sites in new Mexico: Lordsburg weigh station on I-10, the Anthony (westbound) weigh station on I-10, San Jon on I-40 and Gallup on I-40 in New Mexico. Four more weigh stations will be deployed in Arizona soon, and three more sites are planned for Wyoming's highways this year.

OPERATIONS: Heavy Vehicle Electronic License Plate, Inc. is a Phoenix, Arizona-based non-profit partnership focusing on providing transportation solutions for commercial vehicle operations. The organization offers the PrePass service. Membership reflects public officials and private truck operators from Arizona, California, Colorado, Minnesota, Montana, Nevada, New Mexico, Texas, Utah, Washington and Wyoming.

Heavy Vehicle Electronic License Plate, Inc. has contracted with Lockheed Martin IMS to design, operate and maintain the PrePass computer system, AVI technology and associated customer services.

For further information, please contact:

1-800-PrePass (1-800-773-7277).

Video MAPS

What is MAPS? The Multi-jurisdictional Automated Preclearance System (MAPS) is a public-private partnership between government and the trucking industry in Idaho, Oregon, Utah, and Washington.

MAPS jurisdictions are committed to a new way of doing business between themselves and the industry. They are building compatible systems for electronic screening of truck traffic in weigh station bypass programs. They are reducing paperwork by sharing information electronically. They are finding ways to offer "one-stop shopping" so motor carriers satisfy the regulatory requirements of each jurisdiction from a single location. Simply put, MAPS partners have gone from thinking locally to thinking globally.

MAPS welcomes the addition of any state or Canadian province ready to share a vision of streamlined interstate and international freight movement across transparent borders with least-cost regulatory oversight.

The MAPS approach to regional permitting is to offer one-stop shopping for truck size and weight permits, while playing within the rules of each jurisdiction. States cannot offer uniformity in truck size and weight laws, but they can accommodate the trucking industry by issuing permits for each other. The over-dimension permits are issued in observance of the limitations and restrictions that exist within each jurisdiction, at costs set by each jurisdiction.

Video MAPS (cont.)

Electronic Screening - MAPS is not a collective offering a centralized system whereby jurisdictions give up their carrier records. Each of the MAPS partners continues to maintain its own database of information about carriers operating within its borders.

MAPS offers regional over-dimension permitting, but that assumes carriers are first registered to operate in each jurisdiction. Carriers must still contact each jurisdiction directly and meet unavoidable basic registration requirements there (including insurance, bond, and tax requirements).

What MAPS jurisdictions are doing in terms of electronic screening is agreeing to build compatible weigh station bypass systems and share transponder ID codes so that when a carrier approaches a weigh station it trips that jurisdiction's computer records related to the carrier.

MAPS bypass criteria is still being defined, but one can imagine bypassing a weigh station will hinge on three things:

- The carrier must be in good standing with the jurisdiction in terms of insurance, bond, and tax. It cannot be suspended for failing to meet basic registration-related requirements.
- The truck at the station must be legal in terms of size and weight (including height), or it must have an over-dimension permit.
- The carrier must have a good safety record with no indication that it is a "high-risk" carrier. It certainly cannot have an unsatisfactory fitness rating from USDOT or the jurisdiction. Safety screening could factor in the carrier's accident history and vehicle or driver out-of-service rates. Jurisdictions may turn to the FHWA to help establish such specific bypass criteria.

Video MAPS (cont.)

MAPS partners have extensive plans for a network of electronic screening sites with weigh-in-motion and automatic vehicle identification devices.

Washington is automating two sites in 1998 — Ridgefield in the south and Bow Hill in the north — and at least two more by the year 2000 — Marysville and Cle Elum.

Oregon is automating all six of its ports of entry and 16 other weigh stations throughout the state. Five sites will be operational by the end of 1997, at least ten will be added in 1998, and the rest in 1999. Oregon's priority is to complete sites along I-84 in order to match Idaho and Utah's efforts to streamline traffic on that major corridor.

Idaho is automating all six of its ports of entry, including Huetter in the north on I-90 and Sage Jct. in the northeast on I-15. Sites along I-84 will be operational before others.

Utah is automating eight ports of entry, including Perry on I-15 near Salt Lake City, Wendover near the Nevada border, St. George near the Arizona border, and Echo Canyon near the Wyoming border.

MAPS may soon announce a service offering that features unlimited weigh station bypasses for "Trusted Carrier Partners" at a flat annual fee of $45 per truck. Oregon has hired a Transponder Administrator that recommends such a service for that state's carriers. The business model may be exported to other jurisdictions.

Video MAPS (cont.)

Keys to Success:

MAPS is successful today because its partnership is not breaking new ground. Cooperative relationships between government and industry were cemented long ago in the four states that are MAPS members today.

MAPS also owes its success to the fact that it nurtures a close working relationship with the trucking industry. When the formation of MAPS was announced in 1996, the presidents of the four state trucking associations immediately expressed their support.

Contacts:

IDAHO: Alan Frew

Idaho Transportation Department

Phone: (208) 334-8694

FAX: (208) 334-8696

OREGON: Gregg Dal Ponte

Oregon Department of Transportation

Phone: (503) 378-6351

FAX: (503) 373-1940

UTAH:

Utah Department of Transportation

Phone: (801) 965-4559 (DOT Office)

FAX: (801) 965-4847

WASHINGTON: Tim Erickson

Washington State Patrol

Phone: (360) 753-0302

FAX: (360) 586-8233

ITS Applications of DSRC

Roadside Electronic Screening

In order to make efficient use of fixed weigh station and inspection resources, DSRC equipment allows a facility to query a vehicle for identification and other clearance data, then based on that information, signal it to either pull in or bypass the station. The bypass may be granted using a decision algorithm based on a number of factors such as credentials, weight information measured at a previous facility or safety histories. This screening allows the facility to concentrate its resources on vehicles with delinquent fees, improper credentials, poor safety histories or otherwise seen as high risk.

As an example, a hypothetical fixed weigh station facility on the mainline is described. The facility would be equipped with three readers: an advanced reader, a clearance reader and a compliance reader. The advanced reader obtains identification numbers and information about the last clearance event from the power unit tag. The site will be able to access infrastructure-based data that permits automatic real-time screening of credentials. The last clearance event data is used if high-speed weigh in motion is unavailable at the site.

The clearance reader provides a signal to the tag alerting the driver to either by-pass or pull-in to the weigh station. The decision to by-pass is based upon a credential check using information stored in the infrastructure and real-time sensor data such as weigh-in-motion (WIM). Also, there will be random checks (pull-ins) of vehicles that have passed the credential verification.

The driver notification signal will include both an in-cab aural and visual indicator. Note that the driver may only by-pass the station when explicitly receiving the by-pass notification. If no notification is given, then the vehicle must pull-in. The compliance reader insures that tagged vehicles that have been notified to pull-in do not attempt to by-pass the facility.

ITS Applications of DSRC (cont.)

International Border Clearance

There are two types of tags employed in international border: the power unit and an electronic lock tag. The power unit tag application is similar to mainline screening except only a single trip identification number is transmitted from the vehicle in advance of the international border crossing. The specific process is as follows. After a shipping transaction is initiated, the carrier receives notification of the transaction and assigns a trip number to the conveyance. The trip identification number consists of the carrier DUNS number and a five-digit carrier assigned number. This trip number is stored in the power unit tag's memory and is also combined with appropriate invoice data by the export broker/trader and transmitted to the exporting customs administration. At the same time, the import broker/trader will transmit a similar data package to the importing customs administration. As the truck approaches the export customs inspection station, the tag will transmit the trip identification number to an advanced reader. Since the relevant credentials have already been verified by the customs administration (when they received notice of the trip), little real-time processing is required to determine whether the truck should be notified to bypass or pull-in. This same procedure will be used by the importing customs inspection station.

Information about the crossing event will be written into the tag's memory. This information is separate from and in addition to the mainline screening clearance event data described above. It consists primarily of date/time and release status for cargo, driver and vehicle.

The electronic lock tag is used to verify that there has been no change in the vehicle's cargo since the vehicle left the shipper's facility. Specifically, the electronic lock tag can detect if there has been unauthorized access of the vehicle's cargo and can transmit its status to the border crossing inspection station. The purpose of this type of tag is to permit customs officials to inspect the vehicle's cargo at locations other than the border crossing. The tag is then "locked" by customs officials through the use of a transportable reader (e.g. hand held). It can be interrogated at the border crossing for information about cargo access.

ITS Applications of DSRC (cont.)

Driver's Daily Log

If a vehicle has been stopped by a regulatory agency for any reason (e.g., safety inspection, traffic violation), either at the roadside or at a carrier's facility, the agency official may require access to the driver's log stored electronically on the vehicle (e.g., in an on-board computer or in the tag's memory) to verify the driver's hours of service. The common access point for this information will be through the power unit tag and the official will have access to a fixed, transportable or handheld reader to support the access.

Vehicle Safety Inspection Record

If a vehicle has been stopped by a regulatory agency for any reason (e.g., safety inspection, traffic violation), either at the roadside or at a carrier's facility, the agency official may require access to the safety inspection records stored electronically on the vehicle (e.g., in an on-board computer or in the tag's memory). The common access point for this information will be through the power unit tag and the official will display the information using a fixed, transportable or handheld reader.

On-Board Safety Data

This application supports a carrier's download of safety data (vehicle is stopped during download). The data could be stored electronically on the vehicle (e.g., in an on-board computer or in the tag's memory) or generated by sensors that have been installed on the vehicle. Furthermore, if a vehicle has been stopped by a regulatory agency for any reason (e.g., safety inspection, traffic violation), either at the roadside or at a carrier's facility, the agency official may request access to on-board safety data. If the carrier permits the official to access the data (perhaps as a method to reduce time spent in a safety inspection), then the data will be obtained through the power unit tag. The official will be equipped with a transportable or portable (e.g. hand-held) reader.

ITS Applications of DSRC (cont.)

Fleet and Freight Management

It is expected that there will be a large number of proprietary applications that are developed to support fleet and freight management functions. This implies that carriers, shippers, third party service providers, and vehicle owners will be procuring readers to be placed at terminals, warehouses, fueling facilities, commercial scales, truck stops, etc. It is critical that the power unit tags used by a commercial vehicle for other ITS functions also be capable of supporting fleet and freight management.

One such application is Gate Access, which supports automatic request for access to a facility. Its primary function is to provide identification of the vehicle to a facility when the vehicle is stopped awaiting a physical barrier to be moved.

Emergency Vehicle Preemption Request

This traffic function allows an individual emergency services vehicle to be given preemption (priority) at an indicator controller. This will be at the controller for a particular road junction, pedestrian crossing, or highway entrance ramp. The data is sent directly from the emergency vehicle to the next controller along its route.

Electronic Toll Collection

Electronic toll collection is the application of DSRC to simplify the payment of tolls. The DSRC link is used by the vehicle to provide account information to the toll facility. Since the information can be transmitted while the vehicle is moving at highway speeds and does not require any action by the driver, it minimizes the amount of time a vehicle must spend waiting to pay tolls. Furthermore, it reduces the number of toll authority personnel required to collect tolls, since the entire transaction is conducted via the roadside computer. There are over one million electronic toll tags currently deployed to commuters throughout the US.

ITS Applications of DSRC (cont.)

Parking Management

Parking Management systems provide the capability to provide parking availability and parking fee information, allow for parking payment without the use of cash with a multiple use medium, and support the detection, classification, and control of vehicles seeking parking.

In Vehicle Signing

This application supports distribution of advisory information to drivers through in-vehicle devices regarding road conditions and status. It includes short range communications to the vehicle and wireline connections to the Traffic Management System for coordination and control. It includes information distribution to inform the driver of both highway-highway and highway-rail intersection status.

Probe Data Collection

DSRC may be used to estimate vehicle counts and highway link speeds for traffic management and flow monitoring. Data on the number and type of vehicles in the vicinity of roadside readers may be collected using DSRC equipment. Link speeds may be estimated by calculating the travel times between readers. This information may then be used as the basis for commuter alerts, traffic system response or highway system planning.

Intersection Collision System

These systems provide the capability to determine the probability of a collision in the intersection and send appropriate warnings and/or control actions to the approaching vehicles using a DSRC interface. This equipment package also provides the capability that the traffic control signals provide signal indication information to the vehicles using a DSRC interface and the vehicle performs the determination of the probability of collision in the intersection. This package covers intersections between vehicles and railroad at-grade crossings.

ITS Applications of DSRC (cont.)

Roadway Systems for Automate Highway System (AHS)

These systems provide the capability of safely controlling access to and egress from an Automated Highway System. These capabilities shall be provided using DSRC equipment for purposes such as a lane check-in or check-out, and special purpose vehicle signing

Transit Vehicle Local Signal Priority Request

This traffic function allows for an individual transit vehicle to be given preemption (priority) at indicator controllers. This will be at the controller for a particular road junction, pedestrian crossing, or highway entrance ramp. The data is sent directly from the transit vehicle to the next controller along its route.

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